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LAST CALL—CONVENTION NOTICE
King Edward Hotel
June 25, 26, 27, 28, 1928
Ha, Ha! Skinney Wada say
Convention today
Down Toronto way.

MONTHLY REVIEW

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American Electroplaters Society

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VOL. XV JUNE, 1928 No. 6

EDITORIAL

Now we are off to a new start. Let's make it auspicious by resolving that 1928-1929 shall be the most successful year in the history of our society.

First, let's resolve to attend all the branch meetings of our own branch and at least two or three of neighboring branches, and thrill the officers by our enthusiasm and interest in the meetings. If we attend, let's enter the discussions and only think of best answers to our problems and express our opinions, and when challenged, discuss them freely and without personal feeling but with hope that our opinions openly discussed may result in a real live branch result that will reflect credit upon all of us. Second, let's decide that we all owe the society a debt of gratitude for privilege of giving us opportunity of association and to repay same by writing at least one paper to be published in the Review this year.

Last but not least, come to the annual meeting, at Toronto, and if delegates bring credentials and look up the secretary and give them to him that meeting can start early. Make things pleasant for that official and convention committee.

Special Print: "The Metalgoods Industry and Galvanotechnique."
F. Ernst Steiger, Leipzig-Gohlis, Strassburger Strasse 4.

ELECTROLYTIC CHROMIUM PLATING IN THE GERMAN PRESSED GLASS INDUSTRY

By Courtesy Chas. H. Proctor

The excellent qualities shown by electrolytic chromium deposits have given rise some time ago to thorough experiments in the line of chromium coating glass molds. These experiments were undertaken by the firm of Albert Butziger, Leipzig, after this concern had solely succeeded in chromium-coating glass molds with perfect result.

The glass is pressed into engraved grey cast iron molds in a glowing and pasty state. Within a short time the polished inner surface of the mold is being covered with a strong oxide coating which, after several hundred pieces have been pressed, becomes as thick as fire scale. A mold oxide-coated to this extent is unfit for further use, as the glass, when taken out of the mold, will stick, and the articles will be deformed. The mold, therefore, had to be taken out of the factory in order to be thoroughly cleaned and polished in all its parts. Inasmuch as pressed glassware is a mass production fabric, this procedure had to be repeated numerous times, the result of which was that the former sharp outlines of the mold were spoiled by scratch brushing it with steel brushes and emery; in this state the mold could not be used for further pressing action. It was then necessary to re-engrave the mold to its former sharp outlines.

The procedure mentioned above recurred frequently in short intervals with molds that were in constant use.

Considering the formation of the oxide layer which makes the glass molds unfit for use, we may state that non-chromium coated molds may at the utmost be used for 1,500 to 2,000 pressures. After pressing this quantity the molds will have to be rubbed off with emery, cleaned and polished. It has been shown by practical tests that chromium coated molds may be used for pressing up to 80,000 pieces, and only thereafter would it be advisable to clean the mold from adherent dirt or scale by means of a steel brush. The chromium deposit remains consistent, and the mold can be used again for pressing the same number of pieces without needing another chromium coating.

It is obvious that the continuous cleaning of the glass molds

made it necessary to have a great staff of workmen, and that it was extremely expensive to keep these molds in good working order. Chromium plated molds will always furnish high quality pressed glass, due to their constant sharp outlines. This fact, in combination with the above referred to saving of cleaning expenses, ought to induce the German pressed glass industry to take up the chromium plating of molds on a very large scale.

Already towards the end of 1924 Mr. A. Butziger made experiments in chromium plating grey cast iron press glass molds, and although the process at that time was in its first stages only, the results were satisfactory enough to promise further success from continued experimenting in this line. It deserves to be emphasized that in the meantime experiments were made to the end of protecting these molds from oxidation by coating them with other electrolytic deposits, f. i., heavy nickel deposits. These electrolytic deposits, however, were completely destroyed by the extreme heat of the fluid glass after a few pressures had been made.

The firm of Albert Butziger, which has great practical knowledge in the line of chromium-coating glass molds, has meanwhile improved the process to such an extent that grey cast iron molds can be chromium plated without any difficulty. In adding several ingredients to the electrolyte, the throwing power of these solutions was increased to such an extent that even deep depressions were coated successfully.

By means of a special procedure which has been patented in Germany as well as in various foreign countries, the firm of Albert Butziger has succeeded in heavily chromium plating very complicated molds, as well as special parts of molds.

For a similar purpose, the glass factory "Aktiengesellschaft Brockwitz" has installed a complete chromium plating plant in its works, which plant was supplied in all its parts by the firm of A. Butziger, Chromium Coating Plants, Leipzig.

The plant is equipped with the latest improvements and is stated to yield excellent results.

Tanks containing about 1,000 liters of solution have been found most practicable. Inasmuch as a high current density is required when using grey cast iron molds, an aggregate of 8 volts and 1,600 amperes is stated to be most effective for this quantity of solution. In order to heat the electrolyte, the tank is equipped with a steam coil which at the same time, by the means of stop

valves, may be used f or cold water, in order to prevent an undesired high temperature of the electrolyte.

Illustration No. 1 shows a part of the chromium coating plant; in the background of the left side is the principal switchboard for the machinery, and next to it the switchboard with the solution current regulator and the measuring instruments. The chief contact bars, which are also shown in the illustration, have a copper crosscut of 1,000 cubic millimeters which provides for effective contact.

The "Aggregat" as well as the exhaust for drawing off the vapors are fixed at the outside of the chromium-coating tank, as shown in illustration No. 2. These ventilating devices are made of lead and are patented in Germany, as well as in various foreign countries.

It is specially pointed out in this connection that the firm of A. Butziger, Chromium Coating Plants, Leipzig, holds the licence for the patent covering the ventilating devices, taken out by the "Langbein-Pfanhauser Werke A. G.," Leipzig, for Germany and foreign countries.

Inasmuch as the glass molds sometimes weigh up to 300 kilograms each, a special traveling crane was installed above the entire plant, providing for the moving and correct processing of such heavy parts of molds. (Illustration 3.)

In the following an explanation is given in connection with sketch No. 6, showing the arrangement of the plant:

Pos. No. 7 shows a working table on which the molds are finally prepared for chromium plating and then hung on the traveling car. The articles are then moved in the direction of the arrow to Pos. No. 1, the chromium coating bath. When chromium plated, the work is transported to Pos. No. 2 in order to be rinsed in cold water; it is then rinsed a second time in hot water in a tank, Pos. No. 4, and furthermore dried in sawdust in tank, Pos. No. 5. Pos. No. 6 is another small working table, on which the molds are taken off from the traveling car in order to be put on stock.

Pos. No. 3 is a solution in which the chromium deposit may be removed from the molds by electrolytic process, if necessary.

It frequently happens that molds are considerably damaged during transportation or while in the glass factory, especially at the edges. In this event it will be necessary to adjust new parts. A repair of the surface is impossible due to the extreme hard-

ness of the chromium deposit, therefore this deposit has to be removed, which can only be done by means of the electrolytic dechroming solution. The mold can then be repaired in the blacksmith department and again be chromium plated for further use in the pressing process.

Illustrations No. 4 and 5 show ready chromium coated glass molds, No. 4 being a mold for pressing vases, and No. 5 a heavy mold for pressing beer glasses. The chromium deposit is to be seen very distinctly, as well as the sharp outlines.

Due to its great practical experience in this special line, the firm of Albert Butziger, Chromium Coating Plants, Leipzig, is in a position to give any desired information and will do so very willingly. As a result of the embracing practical knowledge of this firm with regard to chromium plating, it has recently chromium coated shoe machinery parts, f. i., thread guides (Fadenfuehrungen), polishing rollers made of grey cast iron (high polish), as well as concave curves; very satisfactory results were obtained, especially with the latter machine parts, and it may be stated that a considerable progress has thus been accomplished in the German shoe machinery industry.

By means of the electrolytic chromium deposit, these curved machine parts become as hard as glass, and parts treated with this process will therefore last much longer than ordinary non-plated parts.

A great number of other fields for application of this process could be mentioned in this connection, but will be treated in a supplementary article. The firm of A. Butziger, Chromium Coating Plants, Leipzig, is very willing to give any desired information to interested parties, also with regard to this lately patented process.

Translated by Hilde Schickert.

SOME RESEARCH WORK DONE IN ELETROTYPING IN SIX MONTHS' OBSERVATION

Robert Suman, Dayton Branch

It is not the purpose to explain electrotyping in all its branches of operation, but to bring out a few points in the making up of electrotype, also the maintenance and control of acid copper and nickel solutions as used for this purpose.

Professor Jacoby was possibly the first to discover the galvanoplasty or electrotyping in 1838. M. T. Spencer and C. J. Jordan also made similar discoveries in the same year. But the more recent discovery was made by Mr. Murray in 1840, which was without a doubt the start of making electrotypes. He made deposits on nonmetalic surfaces using graphides. Dr. Montgomery also discovered it by using gutta-percha for production of negatives, and in more recent years bees wax Venice turpentine asphaltum were used. Recommendations at present seem to be ozokorite compounds with gum turpentine which is most extensively used and proves out the best which gives very little trouble.

There seems to have been very little research work done on electrotyping in accordance to the increased demand. There has been some improvements made in machinery but that alone does not improve or help the deposits which is 95 per cent of the electrotyping industry.

Electrotypes are used mostly for printing plates for magazines, but have many other purposes. Without these plates it would be a very hard problem to make the beautiful colors of the magazine covers in which there is possibly four plates involved. Each plate printing on a separate color and after being finished it makes a very pleasing appearance. Many of these plates have been made from original photographs and rephotographed or transferred on to a copper plate, then this copper plate is etched in acid. This is called the halftone and original plate. This halftone is then taken to the typesetter who sets the type or reading matter that belongs to the halfone—it is then locked up in a form and taken to the electrotyper. The electrotyper takes this set-up and molds it into a wax or lead mold. The wax mixture will be explained later. The lead is a thin sheet of lead and laid on to the surface of the set-up then put under a hydraulic press and pressure run up to 700 to 1,200 ton pressure per square inch. another thin sheet of lead, larger than the impression lead, is coated with wax on both sides to prevent or stop off the plating. This is only used to protect the impression lead from doubling up or getting injured. This is called the case. The impression lead is now tacked on to the above lead case and is ready for the oxydizing solution which is made up of 8 oz. of Bycromate of Potassium per gallon of water. This solution oxydizes the lead, so after the nickel is deposited the lead

stripped off the nickel shell or plate and a reproduction of the impression whatever might have been on the lead is very distinct. The nickel deposit is generally a two-hour deposit. The nickel case is then taken out, rinsed off with a good pressure of water in order to break up the hydrogen gas bubbles that accumulate on the case while plating. This is very essential if the bubbles are not broken or rinsed off and transferred to the copper tank in that condition the copper deposits over the bubbles and causes a blister which is termed by some electrotypers as double shell. after the shell is rinsed off with water it is dipped into a sulphuric acid solution composed of 6 oz. of sulphuric acid per gallon of water. This solution should be maintained at about this strength, for if it gets weaker, a double shell may be the result. The reason of this dip is that the nickel solutions are maintained at about a neutral point and the pure sulphuric acid solution kills all the alkali solution before entering the copper solution thereby not neutralizing your copper solution. Then it is transferred to the copper solution and remains there possibly two hours. This all depends on the thickness of shell wanted. After the nickel and copper has the required thickness of deposit, the shell is then taken to the caster who uses a solution salammoniac 8 oz., 1.5 lb. zinc chloride, 1 gal. water, which he brushes over the back of the shell and lays the shell flat down, putting tin foil over the solder flux. Then putting this shell into a large pan called casting pan. This is then put into the lead pot in which molted lead should be always kept at a temperature of 650° F. for good results. After this casting pan has been left in the lead pot it melts the tin foil and covers the copper shell which gives it a good surface, or in other words, a soldering surface. The casting pan is then lifted out of the casting pot and molted lead is then poured over the shell to the desired thickness. The lead shells are then scrubbed off with coal oil, rinsed and dried; then they are ready to be sawed and trimmed up by the finisher. The wax molding is done similar to the lead molding only waxes are used instead of lead. The wax is melted to a temperature of 130° C. or 202° F., which is smoking temperature and allows all the water to boil out which is very essential. The wax is floated over a thin sheet of lead to the required thickness, then run through a shaving machine which shaves the wax to an even and smooth thickness. This is called a wax case. After that the wax case is put on to the hydraulic press and the master plate

is pressed into the wax. Then it goes to the trimmer or bench man, who trims off the surface and also burns off the sharp edges of the wax. It is then transferred to the dry letter machine. This is a machine in which graphide is used and brushes having an up and down motion in order to coat the wax with graphide. From there the case goes to a wet letter machine in which 50 per cent graphide and water used. The case goes through this machine splashing the graphide on the case in order to get a better surface. After leaving this machine the case is rinsed off and the edges and back are dipped into melted wax to prevent plating. Then the case is oxydized with a solution of 4 oz. copper sulphate, ½ oz. sulphuric acid per gallon of water. Many electrotypers use some copper solution from their tanks and reduce it down. This does not give uniformity after the copper solution has been floated on the case. Some iron filing are sifted on and precipitates copper on the surface of the case. It is then rinsed off and transferred to the copper tank. If it is to be a nickel type it is not copper coated. The time for copper generally runs about two hours and it all depends on thickness of shell wanted. The finishing up of these shells is done about the same as nickel shells. The copper solutions should be maintained at from 7.8 or 9 oz. of copper equal to 27.5 to 35.5 oz. of copper sulphate per gallon and from 3 to 3.5 oz. of sulphuric acid per gallon. This will pull about 75 amperes per case and a good deposit is made. Also it is a good range for your solution as there is a wide variation in which you can carry the solution with fairly good results. It is not impossible to try to keep a copper sulphate solution at one place at all times, but not an easy problem. We have found that if the copper and acid are properly balanced in accordance to the temperature and also anodes taken into consideration the solution would give little trouble for a long time. Some of the troubles that come up from time to time are soft shells. This is mostly caused from an acid condition, in other words, too much acid for the amount of copper in the solution or too much current, also the solution is too hot. Pin holes is another trouble which is mostly caused from poor black lead or that it is not properly polished with black lead.

Nickel solutions have varied in the way of formulas from a regular commercial nickel plating solution to a less complicated solution. The best solution in use today is one given out by the Bureau of Standards—9 oz. of single nickel salts, 7 oz. of salam-

moniac, 1 gal. of water. This solution is very good and of a close grain and hard deposit used at a temperature of about 80° F. and a P. H. of 6 to 6.1, 3 to 3.5 volts. There have been a great deal of experimental solutions tried out but this seems to have worked out with about 98 per cent efficiency and also with very little trouble. It has been claimed by some electrotypers that other solutions deposit more metal at a given time than the above solution given. This may be true, but if tensile strength and also fineness of deposit would be taken into consideration, it would be found that the Bureau of Standards' solution would outlast the other plates on the printing press. Allowing that more metal is deposited in a given time means that the deposit would be softer, more granular and would not stand the pressure as a plate that is close grained and semi-hard and does not crack in curving. This is what the printer wants and what he is paying for. Some experiences of trouble with nickel typing are mostly small pin holes which can be almost all taken care of by watching the P. H. value, as this is the most essential thing about a nickel solution.

In conclusion there are a few things to be considered:

1st. Try to keep the copper solution at from 7.8 or 9 oz. of copper, which is 27.5 to 35.5 oz. of copper sulphate per gallon of solution. This should have from 3 to 3.5 oz. of sulphuric acid per gallon solution. Temperature from 80 to 90° F., 6 volts should be maintained at the dynamo. When the solution gets above 9 oz. of copper there is a slowing up of the deposit. So far as our experimenting has gone it was found to keep below 9 oz. of copper per gallon.

2nd. Soft shells, also a red shell are mostly caused by too much acid, a hot solution, or too much current.

3rd. Missing dots or letters on wax cases can be traced to poor leading or coating. Also after the shell is taken out of the solution and taken off the case, it is not properly rinsed off and a small amount of copper solution remains on the copper shell, this laying around for a few days and starting the copper and acid to work which eats off the small dots. Shells should be thoroughly rinsed off and set up in a rack to drain off.

4th. Good agitation should be maintained at all times in copper and nickel solutions. This enables a uniform solution throughout the tank and also enables a greater amount of current to be used on the plate.

5th. Size of anodes in copper solution should be maintained about the size of cathode surface. If, however, the anode is larger than the cathode, there seems to be a building up of copper sulphate in the solution. If the anode is smaller than the case or cathode, the plate or shell seems to be thin on the edges and not an even deposit.

6th. Amount of solution per case or cathode should be considered. If about 18 gallons of copper solution is provided per case or cathode there seems to be a better condition in the solution. Also the solution is easier to maintain as it does not plate out so fast and is easier to control.

7th. Nickel solutions after being made up as per formula given are very easy to keep up. The essential thing is to match the P. H. value (in other words the amount of acid or alkali in solution). The best results is a P. H. 6. to 6.1. Also the temperature should be about 80 or 90° F., voltage from 3.5 to 5.

8th. The troubles that are noticed most in nickel are holes in the lead shells or plates. There are many things which can cause this. One is that the solution is not properly balanced—also grease spots. A poor oxydizing solution which is Bechromate of potash 8 oz. per gallon of water. This enables the lead shell to be stripped off the nickel plate very easy and without damaging the surface of the impression. The P. H. value is the most essential, however.

9th. Gasing, as the electrotyper calls it, is mostly caused by the P. H. value not being in proper plate together with poor agitation and too much current.

10th. Peeling is another trouble which can be traced to cold solution. Grease spots—also P. H. value not right.

11th. Waxes have given more or less trouble to the electrotyper. The best combination as yet found is Ozokerite 80 lb. Gum Turpentine 10 lb. Beeswax 10 lb. This all depends on weather condition. In hot weather or summer months, this mixture would not prove out so good. The best thing to do is to let the man on the job take care of that. Temperature should be regulated to about 130° C. or 202° F. which keeps the water evaporated and the wax flowing freely.

12th. The lead casting or backing up metal as it is called has a great deal to do with good plates for finishing, temperature should be regulated to about 650° F. at all times. The reason for this is if one shell is cast at 650° F. the next cast at 500° F. there is a difference in shrinkage in these shells and when a color job is run

through it will be a hard matter to register two plates together on account of the shrinkage.

13th. The fluxes or soldering fluid used for casting are usually bought on the open market. Some casters prefer making their own by taking zinc and dissolving in muratic acid. This is all right but not a uniform solution. The best found yet was to dissolve 1.5 lb. of zinc chloride and 8 oz. of Salammoniac per gallon of water. This gives a uniform solution at all times.

14th. Graphides is a very particular point to watch. Be sure to get the best for this will keep you out of trouble in many cases. The wet letter machine is another essential point. This wet letter should be about 50 per cent water and 50 per cent of graphide which makes a very even flow over the case.

15th. Glues. Molasses and many other things have been tried in copper solutions in order to get an even deposit. Adding glues seems to even up the deposits and also makes a finer grain deposit which means a stiffer shell or plate.

16th. Chemical control is the best way to know where your solutions stand. It is also easy to learn how to make this chemical control and all electrotypers working on tanks should know.

17th. Many an electrotyper tries to imitate his fellow member in the solution end of it. The best is to forget this for conditions are different in each shop and one must work according to conditions and surroundings.

18th. Research work is better done and more can be accomplished by teaching the man on the job how to use the chemicals he has to deal with. We have plenty of facilities and chemicals and all that is needed is to have a man who knows the action of chemicals and how to get out of trouble. This is the best research needed at the present day.

19th. Holes and also places in type work on wax casts that do not cover are sometimes caused by an overlap of shading of the wax, or wax that has not been cleaned off the surface and the plate does not go under this overlap. If, however, this is the case, it is most always remedied by rubbing a little graphide over this surface and after replacing into the solution it will be noticed to cover over very readily.

20th. Poor work is also very noticeable when the men are over worked. When this is the case, you can expect very poor co-operation in the shop.

21st. Rough deposits in copper solution are mostly caused by

floating particles of undissolved copper floating in the solution or too much acid. There is need of agitation and a filter of solution.

22nd. Dark and red color especially at edges and corners caused by too much current and too much acid.

23rd. Brown or brown streaks, impurities in the bath—especially arsenic—which are introduced sometimes when adding commercial acid. Working the solution very hard is a good remedy.

24th. It was also noticed that when using commercial acid there is a white sediment in the bottom of the acid carboy. This is lead sulphate introduced in the making of sulphuric acid. If this white sediment is added to the copper solution the plate will be noticed to come out a red color but will gradually work out.

R. G. SUMAN, Dayton, O.

A METHOD OF CHLORIDE DETERMINATION FOR NICKEL SOLUTION

(From Data Compiled by Lee D. Boyce and E. Steen Thompson, Cleveland Branch)

Due to the increasing popularity of 99 per cent anodes either cast or rolled and the freedom from sludge in the tanks worked with them, the necessity has arisen for a check on the chloride content of nickel solutions used in connection with them, since their use requires better corrosion conditions than with the old 96-98 per cent anode.

Accurate chloride analysis requires too much time and too much equipment for the average plater to practice, therefore this short cut test for comparative purposes of the chloride content provide the following equipment: A small size test tube, about ¾"x4 to 6" long; two medicine droppers, the orifices of which should be as nearly the same size as possible; a brown glass reagent bottle, about 500 c. c. capacity; a second reagent bottle of about twice the capacity of the last one, not necessarily brown glass.

Make up the following solutions:

Solution No. 1: Add to 1 liter distilled water sufficient Potassium *Chromate* (not Bichromate) to render the solution a deep yellow. This solution is used as an indicator and exact quantities are not necessary.

Solution No. 2: Make up, using 500 c. c. distilled water with

18.05 grams of silver nitrate, using the brown bottle as a container for same.

Procedure: With one of the medicine droppers obtain a sample of the nickel solution to be tested, and drop exactly 10 drops of the sample into the test tube.

Add enough of the Potassium Chromate Solution to this 10 drop sample to make about ½ inch depth in the test tube. Now with the *other* dropper commence dropping some of the silver nitrate solution into the tube containing the sample, counting each drop and agitating the tube while doing so.

A white precipitate will be formed of silver Chloride which will be suspended in the yellow sample—the end point is reached when the sample turns to a chocolate brown, which will occur with the first drop of silver nitrate added after all the chloride is thrown down.

Include in your count the drop which renders this change and the number of drops of silver nitrate solution used represents in tenths of an ounce avoirdupois the amount of chloride per gallon in the nickel solution.

This test is purely comparative and will give results close enough for control purposes without elaborate analyses.

	Molecular Weight	Equivalent Weight
H Cl	36.5	36.5
(NH_4) Cl	53.5	53.5
Na Cl	58.5	58.5
$Ni\ Cl_2$	130.00	65.0

The above equivalent weights of the chlorides commonly used will show the closeness of control by this method so that the change from one chloride to another may be made without seriously affecting the results of the test.

MONTHLY REPORT TO THE AMERICAN ELECTROPLATERS' SOCIETY

By H. L. Farber, Research Associate, on the Subject of Chromium Plating

A review of the principal publications on chromium plating was first made. A card index file was arranged for all these articles and their specific topics. The objects in this study of the literature are to check any work already done which might be used as helpful information in the work to be carried on and to

compare the results obtained by others with any data obtained in our future work.

Outlines of the problems to be studied and the methods of procedure were worked out. The research projects chosen for immediate work are:

(A) Throwing power in chromium plating.

(B) The application of chromium plate to various metals.

Factors determining the throwing power of chromium solutions (project A) are (1) current efficiency, (2) conductivity of the solution, (3) cathode polarization, and (4) plating range. The variables affecting these properties and therefore the throwing power are composition and temperature of the solution, current density and surface to be plated. From the experiments planned we hope to determine the range of conditions within which good deposits and the best throwing power can be obtained.

In the research on the application of chromium plate (project B) a study will be made on the best conditions for obtaining satisfactory chromium plate on various metals for any given requirements such as appearance, resistance to wear, resistance to corrosion, etc.

Among the factors involved in the above problem are:

(1) Base Metal:
Kind and condition.

(2) Treatment Prior to Deposition:
Cleaning, plating with other metals, etc.

(3) Constituents of the Solution:
Concentration, etc.

(4) Condition of Plating:
Temperature, current density.

(5) Composition of the Deposit:
Occluded hydrogen, oxygen, other metals and their removal.

(6) Stresses:
In the plate and in base metal.
Effect of annealing.

(7) Structure of the Deposit.

(8) Porosity of the Deposit.

On the knowledge and standardization of the above factors depend the production of satisfactory chromium plate and the solution of many problems confronting the plating industry today.

Respectfully submitted, H. L. FARBER, Research Associate.

Researches on Chromium Plating in Progress or Contemplated

I—*Principles of Chromium Plating,* H. R. Moore:

A—Constitution of the baths, especially the composition and form of the so-called "chromium chromate." A study of the conductivity, specific gravity, and optical characteristics of (a) pure solutions of chromic acid, and (b) solutions containing known amounts of (1) sulphates and (2) trivalent chromium. This investigation has just been started and will probably require about a year's work.

In the light of these results other studies on the theory of chromium plating will be undertaken.

II—Conditions and Methods of Chromium Plating, H. L. Farber, Research Associate:

A—Determine effect of both composition, temperature and current density upon (a) throwing power, (b) plating range, (c) cathode efficiency, and (d) the structure and properties of the deposits. (A) is now just being undertaken by Mr. Farber, and will probably require about three months. Some data on (b), (c) and (d) will be obtained incidentally, and may serve to confirm or extend the observations of Haring and Barrows and others.

B—Determine the most favorable conditions for producing chromium deposits with desired appearance, hardness, or protective value, on different metals including brass, steel and iron, and aluminum, zinc, nickel and tin and their important alloys.

The need for more exact information on this subject is illustrated by the present lack of agreement regarding the necessary thickness of chromium on brass plumbing fixtures and the desirability and practicability of applying a preliminary coating of nickel. There is considerable demand for information on the methods and value of chromium plating on aluminum alloys for protection against either corrosion or abrasion. The recent paper of H. K. Work on the nickel plating of aluminum and its alloys will no doubt help in such a study. This part of the investigation will be so conducted as to permit publication of progress reports, relating e. g. to each kind of base metal, at intervals of a few months.

III—*Control of Chromium Plating Processes:*

In the light of the above studies, favorable conditions of plating for any specific purpose may be defined. The maintenance of those conditions by chemical analysis; replenishment of the solu-

tions; their regeneration (e. g. by the removal of trivalent chromium or of iron); and means for controlling the temperature and current density, will then be studied.

In this connection we have arranged to make a brief study in co-operation with the Public Health Service, of the health hazards in chromium plating, and the most effective means of eliminating them. Several requests for such information have already been received from state and city health officials. A brief investigation will at least indicate the extent to which such hazards exist under present conditions.

IV—*Properties of Electrolytic Chromium,* G. E. Renfro:

Chromium plating owes most of its applications to specific properties, which fit it for certain uses. Many of these properties have never been exactly determined, or if so, they were measured with cast chromium of unknown purity. It is at least possible that some of the properties of electrolytic chromium are appreciably different from those of cast chromium. As the Bureau has in its various Divisions facilities for making most of these measurements, the work of the electrochemistry section will consist chiefly in preparing specimens of the required shape and size. In many cases this will require considerable ingenuity. Among the properties under consideration are the following:

(1) *Hardness:* Use of the scratch harness method or other means for measuring the relative hardness of different chromium deposits. (Metallurgy Division.)

(2) *Wear Resistance:* Much work has already been done on the service of chromium plated gages. These tests will be completed and tests will also be made with the "Amsler" and other wear testing machines. (Metallurgy Division.)

(3) *Coefficient of Expansion:* This is important in connection with the use of chromium plating at high temperatures, e. g., on glass molds. If possible, cylinders of pure chromium will be prepared for this purpose by depositing a thick coating of chromium on a copper tube, which will be dissolved out with nitric acid. (Weights and Measures Division.)

(4) *Specific Gravity:* This is important because it is involved in most calculations of the thickness of the deposit. (Weights and Measures Division.)

(5) *Reflecting Power:* Preliminary measurements have been made by the Bureau. This property determines the value of chromium on reflectors. (Optical Division.)

(6) *Color:* Measurements will be made to determine whether there is any difference in the color of chromium deposited under different conditions or on different base metals; when the deposits have the same luster. (Optical Division.)

(7) *Melting Point:* This can probably be determined accurately by passing a current through a cylinder of chromium and observing the temperature when it melts. (Heat Division.)

(8) *Electrical Conductivity:* This may be of interest in connection with the use of chromium plating on conducting wires or other parts of electrical equipment. Methods for preparing suitable specimens will require some investigation. (Electrical Division.)

(9) *Tensile Strength and Elongation:* It is doubtful whether reliable measurements can be made on so brittle a material as chromium. They will be attempted, however, as the results would be of decided scientific interest. (Mechanics Division.)

(10) *Surface Tension:* A property that may contribute to the protective value of chromium plating, is the readiness with which the chromium surface is "wet" by water or other liquids. The tendency of oils to wet chromium surfaces may also affect the value of chromium on bearings. If possible a few measurements of this property will be made. (Friction and Lubrication Section.)

(11) *Resistence to Oxidation at High Temperatures:* The temperature at which chromium when heated in air starts to tarnish or oxidize will be determined both from its appearance and change in weight.

(12) *The Protective Value* of chromium plating when applied directly or over coatings of other metals upon steel and brass will be determined under normal and accelerated conditions of exposure.

READ AT EDUCATIONAL MEETING OF CHICAGO ANNUAL BANQUET, JANUARY, 1928

Discussion of Nickel Treeing on Tank Walls

Mr. Service: Mr. Elliott of Belvidere, Illinois, has brought some samples of nickel treeing that form on the sides of the tank and he wishes some information as to how this might be prevented. This (indicating) came off of the walls in a double nickel salt tank, but the plating on the cathode was okey. The plate seemed to spread all over the sides of the tank. This for-

mation is caused during electrolysis in a nickel solution. Is there any suggestion?

Mr. Proctor: What is the tank lined with?

Mr. Elliott: Asphaltum lining, sediment removed every six months.

Anonymous: I would suggest that you remove your anodes from too close a position to the lining.

Mr. Wilmore: Isn't it possible that they have been using some of this so-called "rubber lining"?

Mr Elliott: No, we use no rubber lining.

Mr. Morita: Is that below the solution?

Mr. Elliott: Yes.

Mr. Wilmore: It is certain that you have a conductor of some kind or you wouldn't get a deposit. It seems that that must be in your lining.

Mr. Elliott: This tank is twenty years old and if it had been something I just learned lately I would have thought it might have been caused by iron filings having blown into the solution, but this is a tank that has been used for twenty years.

Mr. Proctor: I should think the solution would be from this angle: Mr. Nixon has mentioned the great amount of sludge found in the tank. Now it is a question of how close these anodes are to the tank itself. The back of the anode becomes a cathode due to change of polarity. If there was a polarity in that tank, which must have been true, otherwise you wouldn't have gotten such a deposit, you might take some glass and by putting it back of the anodes themselves, see if you can't prevent that small amount of metal from getting into your asphaltum, and I think you will solve your trouble.

Anonymous: That result of course must be due to some connecting material in the lining or it might start from a point and spread over a large area. Of course you can easily see how the tank might have been charged negatively on your anodes. Now if that installation is poor on the cathode rod of course your tank will be charged negatively and wherever there is a metallic contact to any part of the lining you will have a tendency to plate there. The fact that you can get a uniform coating over any side of the tank would indicate that there is some conducting material in the lining.

Mr. Servis: I have observed that condition especially where

the lining of the tank has deteriorated. If you recline your tank you probably won't have any more trouble.

Mr. Rhinehart: What type of anode do you use?

Mr. Elliott: 90-92.

Anonymous: Do you polish copper anywhere around the place?

Mr. Elliott: No, we do not.

Anonymous: There seems to be some fine pieces of copper on this surface. It might have been brass.

Mr. Mamero: Is the work-rod insulated from the tank or is it resting right on the tank?

Mr. Elliott: No, there is an insulator.

CONVENTION FORECASTS

Some little bird has been circulating discordant sounds which, when interpreted, mean that serious difficulty will be experienced with regard to securing accommodation at Toronto hotels in June. We have advised early reservation since first notices of convention dates were sent out, and while we admit that the hotel situation is not, and will not be, as we would like to have it, we have been assured by the managers of the best hotels that those attending the A. E. S. convention will be taken care of, so cease worrying and make your reservations now, be happy and come with the assurance that we will do our best to give you a good time.

Joe Ellis says that he will sing E. G. Lovering's latest sneeze, "Where the Red, Red Noses Blow," if someone will set it to music. Let's hear from the composers now.

We realize we will not please all, in fact we may get arrested for staging a BUM show, but if the Aumsement Booking Agencies have their way you will get a regular STAMPEDE IN FOUR REELS at the Banquet.

We have just sold exhibit space, which will be used to show a new and important piece of equipment, so that's one attraction anyway. The progress and changes of the last twelve months can best be seen and studied at this great annual meeting of Electroplaters. The convention room, exhibits, registration and information, booths, committee rooms, etc., will be on the Mezzanine floor, everything handy.

Banquet and Dance will be held in the Crystal ballroom, King

Edward hotel, Wednesday evening, June 27. Just had a letter from a feller 'way out in Which-er-tother, Kansas, saying he was coming to the banquet, he's a friend of the A. E. S. poet and we expect he will bring him along, too, so that another at . . . wait a minute, . . . another smiling face you'll see if you come.

We haven't heard a darned word from any of the ladies whom we expect to come, with reference to their choice of entertainment, it's too late for a sleigh ride and too early for a corn roast, so we guess a soft ball game by Toronto's famous ladies' teams will give 'em a chance to let loose and yell to their hearts' content, and believe me—I mean us—no—us means we, and believe we, gee, that don't sound right—anyway, the girls are wonderful ball tossers and the most popular high grade attraction in Toronto during the summer months.

A Toronto paper says Prof. Jastrow advises mentally tired folk to "take a relaxative." Well, now that's just what the Toronto convention is going to be, therefore we agree with the professor. We have "guesstimated" the attendance will be five hundred, that's four hundred and ninety-nine besides you, brother. *Pardon me, Frank.*

At this writing we expect to have the official photograph taken at Niagara Falls, upon arrival of the A. E. S. delegation Tuesday afternoon, June 26th. This feature should not be "MIST" by anyone (that's a raw one).

Anyone desiring to ride over the Falls a la Bobby Beach, should apply to one of the supply houses for a loan of a TUMBLER.

Forget your cares and troubles.
They will disappear like bubbles,
And float away on air, long 'ere you know it.
Come along to the convention;
Tell the world of your intention.
You will feel a whole lot younger and you'll show it.

W. S. BARROWS, Secretary,
Toronto Branch Convention Committee, American Electroplaters' Society.

1928 JUNE ISSUE REVIEW

A. E. S. PAGE

Assembled Expert Scraps With and Without Significance

Famous Last Words—

"Oh, Mr. Editor! You spelled my name wrong."

The reason so many bootleggers hang out at gas stations: They collect the old crank case oil.

The Germans have developed a pill which cures insomnia. Don't know what it's made of, but lead is the favorite material of our most efficient assassins.

Proper Mixture Needed——

A man, like a watch, is of little use without a head containing the right ingredients. —*Forbes Magazine.*

The Gamble——

Life is like a game of cards. . .
When you're in love, it's hearts:
When you're engaged, it's diamonds:
When you're married, it's clubs:
When you're dead, it's spades.

Mary: "Molly just worships her husband."

Sally: "Yes, I heard that she placed burnt offerings before him three times a day."

Honesty is one thing that can't be improved on.

Mighty few of us acquire polish from the grindstone of adversity.

Famous Last Words——

Don't wait up, dearie—I may be late.

Meet Chromium the 24th Element——

How many of the ninety-two chemical elements that constitute the universe do you know?

The Chicago Evening American is presenting a series of discussions of the elements, following the confirmation by Italian scientists of illinum, element No. 61, which was discovered by scientists at the University of Illinois and gets its name from that institution.

Chromium, element No. 24 in the scale according to atomic weight, has familiar uses in every day life for the insoluble chromates are useful as pigments, and nearly every one is familiar with the color, chrome yellow.

Chromium is an element somewhat resembling iron that chiefly occurs in chrome iron ore. It occurs most commonly in serpentine rocks. California is the only state now producing chromium, but Cuba has great masses of this ore.

Not infrequently the handicap of a good liver is his bum liver.

Fortunate is the man who learns a lot from a little experience.

You Can't Learn——

—Everything by listening only to those with whom you agree.

—Much by listening exclusively to your own remarks.

—Enough to be contemptuous of anybody's honest opinions.

—Much from many, but you can learn something from everybody.

—Life's lessons by running away from hardships.

The Joy of Being an Editor

Getting out this paper is no picnic.

If we print jokes people say we are silly.

If we don't they say we are too serious.

If we clip things from other papers we are too lazy to write them ourselves.

If we don't we are stuck on our own stuff.

If we don't print contributions we don't appreciate true genius.

And if we do print them, the paper is filled with junk.

If we make a change in the other fellow's write up, we are too critical.

If we don't we are asleep.

Now like as not some guy will say we swiped this from some magazine.

We wouldn't deny that 'cause WE DID.

Send It In——

If you have a bit of news,
Send it in;
Or a joke that will amuse,
Send it in.
A story that is true,
An incident that's new,
We want to hear from you.
Send it in.
Never mind about the style,
If the news worth the while,
It may help or cause a smile,
Send it in.

New Varnish Invented in France——

It is reported that a new product known as "Melanite" has been introduced recently in France. The claims set forth by the inventors are that the varnish is waterproof and impervious to oil, petroleum, tar, ink, sulphuric acid and other deteriorating agents. The material is used in conjunction with an underlayer and when applied is claimed to produce with any color a matchless finish, different from ordinary paints and varnishes, which does not crack, chip off, or scratch and resists shocks. The underlayer is said to be an excellent protective coating for iron, steel, brass, copper and aluminum. The product is manufactured by a cold process and one kilo of the material will cover approximately 15 square meters. The cost of production in large quantities is stated to be about 4½ francs per kilo, including raw materials. The sales prices are from 10 to 15 francs per kilo in containers of ¼, ½, 1, 5, 10, 50 and 100 kilos.

"Melanite," according to the introducers, is especially adapted for use in finishing automobiles, furniture, glassware, textile bobbins and metal containers. It is stated that the trade name is registered and the price will be 8 to 12 francs per kilo. The inventors are contemplating the erection of a plant near Paris.—*Commercial Attaché H. C. MacLean, Paris.*

Didja Know—

Chas. Weston of the Chicago Branch A. E. S. is in the Francis Williard Hospital, Chicago, Ill.

It's not what you earn and spend, but what you save and have that determines your true financial standing.

Knowledge can be acquired from books, but wisdom must be won by living.

THE GOLF SONG

(Actually Original and Copyrighted)

"My Country 'Tis a Tee."

WHAT'S IN A NAME?

Dr. Minnie M. Heal is a chiropractor.

H. J. Bridegroom is a justice of the peace.

B. Straight is manager of the Crook Candy Co.

MEET THE NEW
WORCESTER-MASS. BRANCH

(New Branch Organized)

ELECTRO PLATER FOREMEN MEET

Vote to Organize Branch Here of American Society

Delegates, comprising foremen of nearly all Worcester electro-plating plants, met recently in the Bancroft hotel and unanimously voted to organize a branch society of the American Electro Plating Society.

Officers will be elected at the next meeting to be held at the hotel, May 28. A committee to complete plans for the session was appointed. It includes R. H. Bryant of the North Works, American Steel & Wire Co., A. A. Brunell of the A. A. Brunell Electro Plating Co., and G. A. Jones of the Reed & Prince Co.

R. J. O'Connor of Bridgeport, chairman of research, presided at last night's session. The speakers were George B. Hogaboom, New Britain, Conn., and Frank J. Clark of Springfield.

The American Electro Platers' society is an educational organization devoted to electro plating and finishing of metal problems. It has a membership of more than 1200 foremen of electro plating companies with 20 branches in the United States and two in Canada.

It supports two research associates, located at the United States Bureau of Standards, Washington, D. C. The annual session of the organization will be held June 25-28 inclusive at Toronto.

R. H. BRYANT, Temporary Secretary.

NEWARK BRANCH

Newark Branch held an open meeting on June 1, 1928 with 43 present. All officers being present with the exception of Mr. Geo. Onksen, who is now located in Anderson, Indiana. (We certainly miss you George.)

Mr. Harry C. Flanigan and Mr. C. E. Stiers were accepted by transfer from New York Branch and responded with a few well chosen words when President Chas. Bohler called upon them. The fishing trip committee reports progress having hired the two steamers for Saturday, August 11th.

Mr. George B. Hogaboom, Past Supreme President, with fitting words very ably installed the new officers for 1928-1929.

Mr. Samuel Taylor our librarian gave a lecture on the etching of silverware, giving in detail methods used from start to finish. Samples of his work were on exhibition in the different stages. All present enjoyed this instructive and interesting lecture. Refreshments were served at the close of the meeting.

Newark Branch held its business meeting on May 18 with 19 members present. President Chas. Bohler, presiding. One active member was elected. We regret to learn of the death of Mr. Geo. C. Barton an active member of our Branch.

Election of officers resulted as follows: President George J. Wagner; Vice President, Wm. De Voti; Secretary-treasurer, Royal F. Clark; Librarian, Samuel R. Taylor; Sergeant at Arms, Wm. F. Harrison; Trustees, Chas. H. Bohler, Lewis H. O'Donnell, Alfred Vaughan; Delegates to Toronto Convention, Horace H. Smith, Oliver J. Sizelove, Philip Sievering; Alternates, Royal F. Clark, Alfred Vaughan, A. Calabrese. Mr. S. R. Taylor spoke on the methods of silver plating, also sand bobbing of silverware as practiced by a large silverware manufacturer in Rhode Island. At the June 1st meeting, which is an open meeting, Mr. Taylor will speak on the "Electrolytic Etching of Silver," exhibiting samples of same.

Discussion on chromium plating and the ball burnishing of brass articles was indulged in until 10:30 when adjournment took place.

ROYAL F. CLARK, Secretary-Treasurer.

PITTSBURGH BRANCH

We held our regular meeting Wednesday evening, June 6th, in the downtown branch, Y. M. C. A., with a good attendance, and it looks as if the members of Pittsburgh Branch will like the change of meeting night from Saturday. Ralph James Paddock was elected to an associate membership. We had considerable business to take care of, and the committee at work on the program of education meetings this coming fall and winter feel that with the list of speakers so far arranged for, we will have one of the best programs arranged in the history of the branch. Every member will have something to call him to the meetings, and at the same time interest others in our work. The convention took up considerable time and we expect a goodly number going, some of whom will surprise the boys upon their arrival, and is going to make a stir. It was decided not to hold a Branch meeting during the month of July, as the Fourth falls upon our regular meeting night, so will meet the first Wednesday night in August.

S. E. HEDDEN, Secretary.

TORONTO BRANCH

The Toronto Branch held its regular meeting on Monday evening, May 28th, when a good number of members were present. The following members were elected as officers for the coming fiscal year: President, John Walker; vice-president, Ben Deaken; sergeant-at-arms, M. Phillips; trustees, J. Acheson, O. Keefe, W. Cummings; secretary-treasurer, Wiliam John Sutherland, 197 Gillard avenue, Toronto; delegates for convention, J. Ellis, W. J. Sutherland, H. W. Graham. This being the last meeting previous to the convention the rest of the evening was spent in discussing the same. With best regards and hoping to meet you in Toronto, I remain, yours truly,

J. ELLIS, Secretary-Treasurer.

PHILADELPHIA BRANCH

Regular meeting of Philadelphia Branch was held June 1st at the U. of P. with the president, Geo. Gehling, presiding.

We had the pleasure of having Mr. Floyd Taylor, of the Harson-Van Winkle Mining Co., who gave an interesting talk, explaining the uses and advantages of the volt, ammeter and rheostat. This talk was appreciated by the members present, as shown by the applause given Mr. Taylor at the conclusion of his talk.

The question was asked, How can steel be removed from a copper strip without injury to the copper?

Answer: A strong hydrochloric acid pickle with the additional piece of copper would form an electrolytic cell and remove the steel from the copper.

Question: How can excess zinc be removed from a nickel solution due to the plating of die castings?

Answer: Raise P. H. of solution to 6.7. Zinc hydroxide will precipitate out the addition. Calcium carbonate will help to carry precipitated zinc to bottom. Siphon off clear solution.

It was also stated it was cheaper to make new solution.

Special notice: July meeting will be held July 13th.

PHILIP UHL, Secretary.

HARTFORD-CONNECTICUT VALLEY BRANCH

Our regular meeting was held on May 28, 1928, at the Hartford Chamber of Commerce at 805 Main street, Hartford, Conn., with President Elwin in the chair. Minutes of the previous meeting were read and approved. Communications were read. All bills were ordered paid.

The Chairman of the Banquet Committee made a report and the committee was discharged.

The Educational Session and Banquet, held by the Hartford Branch, and incidentally its first one, was a big success. There were nearly two hundred who attended a very interesting educational session with speakers of much note. The branch was fortunate to secure the services of Past President Geo. B. Hogaboom to act as chairman at this session. The banquet in the evening was one which will long be remembered. It was a joyous affair throughout, and was attended by one hundred and forty-one persons.

Officers were elected for the coming year as follows: President, Elwin, re-elected; vice-president, W. T. Jordan; secretary-treasurer, V. E. Grant, re-elected; librarian, W. J. R. Kennedy, re-elected; board of managers, Chas. Dunn, Edw. Fleming and Jos. E. Beloin; delegates to national convention, W. T. Jordan, Jos. E. Beloin and Edw. Fleming; alternates, L. J. R. Kennedy, J. A. Bagshaw and H. R. MacFadyen.

Mr. A. L. Keller, Work Manager of the Maas & Waldstein Co. of Newark, N. J., gave a very interesting talk on the Manufacture and

Use of Lacquer and Lacquer Enamels. His talk was thoroughly enjoyed by us, and in conclusion was given a rising vote of thanks.

The meeting was attended by thirteen members and visitors, and was adjourned at 10:30 p. m.

V. E. GRANT, Secretary-Treasurer.

CHICAGO BRANCH

Regular monthly meeting of Chicago Branch held at Atlantic hotel June 9th, 1928..

President Robert Meyers called the meeting to order at 8:15 and the members sure were there, it being one of Chicago Branch's big nights, the annual smoker and installation of officers.

The business of the meeting was conducted by President Meyers, who in turn gave the gavel to Mr. S. E. Huenerfauth, the Chairman of the Smoker Committee.

After several musical numbers, given by Mr. J. De Grazio's two sons, also Mr. O'Malley and Mr. Maxfield, the gavel was given to Past President F. J. Hanlon who, in his proficient way, conducted the installation of officers.

Mr. Hanlon had Mr. O. E. Servis, Mr. H. A. Gilbertson and Mr. F. L. Greenwald, all past presidents of the branch, as Marshalls to help him with the ceremonies.

Robert Meyers, president; Gustav Jelinek, vice-president; Samuel J. C. Trapp, secretary-treasurer, and O. E. Servis, librarian, were duly installed.

The Marshalls then proceeded to bring Mr. C. Kocour, F. L. Greenwald and H. Alt to the rostrum to be installed as the board of managers.

After the installation of officers, the Chairman of the Convention Booster Committee again reported that everything was in readiness for the big trip, and there were a number of reservations made, and the members and their friends still have time to make their reservations.

The night being well taken up, the question box was held over until next meeting, as the entertainers were anxious to do their stuff.

The smoker night is one night the members turn out because it is like a homecoming, where members meet their fellow craftsmen, and it is one continuous hand shaking, and the good fellowship of the branch is shown on this night.

Mr. Jack Geissman of Milwaukee Branch is ever ready to assist in making the entertainment a success. He told stories and sang several songs.

Then we had one of Chicago Branch's own members who is the life of the branch when he comes to the meeting and he sure was there at the smoker telling jokes that kept the members in an uproar continuously. We write all this before we mention his name, as a great many members already know who it is but to those who are not ac-

quainted with this member, we will now tell you it is no other than Mr. David Greenblatt, and those who do not know David, come to the meeting and get acquainted with him.

Chicago Branch extends its thanks to Mr. S. E. Huenerfauth, F. L. Greenwald, H. A. Gilbertson, O. E. Servis and E. Lamoureaux of the smoker committee for the success of the night. Also to Past President F. J. Hanlon and his Marshalls for the way the installation was conducted. And last, but not least, to the entertainers, Mr. De Grazio's two sons, known as Mike and Herman, Mr. Jack Geissman and Mr. David Greenblatt. Also to the other two entertainers.

The night was of merriment until 11:30.

Mr. R. L. Kelly, vice-president of Chicago Branch A. E. S., 1927-1928, was taken to Garfield Park Hospital June 12, to be operated on for hernia. We offier our sympathy to the member in his affliction.

In Memoriam

It is with keen regret and sympathy that we announce the death of F. E. Nikolas, a regular attendant at our conventions, and son of G. J. Nikolas, one of our oldest and esteemed members. We offier his parents and wife our deepest sympathy in their bereavement.

S. J. C. TRAPP, Secretary.

MEET THE NEW BALTIMORE-WASHINGTON BRANCH

Headquarters, care of F. F. Pierdon, 925 E. St., N.W., Washington, D. C.

New Branch Is Organized

A meeting was held Saturday, May 26, 1928, in the Southern Hotel, Baltimore, Md., for the purpose of organizing a branch of the American Electroplaters' Society. The arrangements for this meeting were made by William W. Chace. The meeting was addressed by H. Smith, supreme vice-president, who stated the object of the meeting and then asked for the election of a temporary chairman. F. F. Pierdon was elected chairman. He called for the election of a temporary secretary. This office was accepted by F. Collins.

George Gehling, supreme secretary-treasurer, explained the aims of the Society and the usual procedure in organizing a branch. Dr. William Blum spoke of the research work of the Bureau of Standards and of its benefit to members of the Society. He offered the use of a room at the Bureau for such meetings as are held in Washington.

George B. Hogaboom talked of the development of technical education among members and explained the methods of acquiring such knowledge and the opportunities open to members.

George Gehling discussed the difference between active and associate members, and imparted other information and good advice. Messrs. Barrows and Farber, research chemists at the Bureau of Standards, rendered a few remarks, stating that future meetings would be educational.

Thomas Slattery, superintendent of plating at the Bureau of Printing and Engraving, showed how the society had been of benefit to himself and others in qualifying for positions of greater responsibilities. H. H. Reama gave a few encouraging words, followed by Mr. Stevens, who

pointed out the duties of members in regard to mutual help and good fellowship. A standing vote of thanks was given William W. Chace for his preparation of the meeting and other efforts.

It was unanimously decided to apply for a charter, the branch to be known as the Baltimore and Washington Branch of the American Electroplaters' Society.

A second meeting was held in Baltimore on Saturday, June 9, at which Mr. Pierdon presided and Mr. Turner acted as secretary. It was decided that for the present one meeting will be held each month, on the second Saturday. The next meeting will be held on Saturday, July 14, at 7:30 p. m., in the Chemistry Building of the Bureau of Standards, Washington, D. C. Permanent officers of the branch will then be elected. A talk on chromium plating will be given by Dr. Blum, and the plating laboratories will be open for inspection. All platers and plating chemists in the vicinity of Baltimore and Washington are invited to attend this meeting and to join the Branch Society.

F. F. PIERDON, Secretary.

DEPARTMENT OF COMMERCE
Bureau of Standards
Washington

WB:LLC April 16, 1928.

Dear Sir:

1. At the request of the Research Committee of the American Electroplaters' Society, we are enclosing for your information a progress report upon the study of spotting out, up to March 1, 1928. This study is being conducted by W. P. Barrows, Research Associate of the American Electroplaters' Society, whose salary and expenses are paid from the Research Fund subscribed by various manufacturers and by Branches of the Electroplaters' Society.

2. It should be emphasized that there are two entirely distinct types of spotting out, which have no necessary relation to each other. As indicated in this report, most of the laboratory work on the crystal spotting has been completed, and the study of stain spots is now being undertaken. One purpose in distributing the progress report at this time is to obtain comments, and criticisms that may be considered and incorporated in the report as finally printed. We will be glad to receive information that appears either to confirm or to contradict the conclusions thus far reached, and also any suggestions regarding other possible remedies for the crystal spotting.

Respectfully,
GEORGE K. BURGESS, Director.

Enclosure:

Progress Report.

CRYSTAL SPOTTING OF SULPHIDE FINISHES

W. P. Barrows, Research Associate of the American Electroplaters' Society at the Bureau of Standards

(Summary of Research from Jan. 15, 1927, to March 1, 1928.)

I—INTRODUCTION

In order to determine the nature and scope of the "spotting-out" problem, visits were first made to a number of plants, especially those engaged in the manufacture of builders' hardware. Examination of the samples obtained from these and other sources, showed that there are at least two types of spotting out. The first, observed only on lacquered sulphide or "oxidized" finishes, occurs in the form of "dendritic" (tree-like) crystals, usually with a black or nearly black color. These have been designated as "crystal spots," and have formed the principal subject of the investigation up to this time. The second type, observed most frequently on cast metals, consists of irregular areas of various colors, to which the term "stain spots" has been applied. This subject is now being studied.

In the experiments upon crystal spots, information was obtained not only from numerous platers and chemists connected with plating; but also from persons engaged in the study of lacquers, varnishes and paper, both at the Bureau and in commercial plants; and from metallographists, mineralogists, petrographers and X-ray investigators at the Bureau of Standards, Bureau of Chemistry and Geophysical Laboratory. The large amount of time consumed in such visits, conferences and correspondence was fully justified by the helpful suggestions received.

The principal experiments conducted and conclusions reached, will be summarized in what now appears to be their logical order, instead of in the chronological order in which they were conducted. Because of the many factors which might have a bearing upon the problem, and the impossibility of anticipating them, it was frequently necessary to repeat certain experiments after the effects of other variables were subsequently detected. Owing to the fact that the occurrence of these spots is not uniform or quantitative, it was necessary to subject at least ten or twenty specimens to each set of conditions in order to obtain reliable "average" performances. Most of the specimens were prepared in the laboratory, but wherever feasible, corresponding plant samples were included in the tests.

In order to obtain at least comparative results in a short time, an accelerated test was developed after certain preliminary experiments had been made. Unless otherwise stated, the tests were made by storing the specimens in contact with ordinary rubber bands, in a closed desiccator at ordinary temperature and 90 per cent humidity. Under these conditions spots usually appeared in from one to three days; while in the absence of sulphur or rubber it often required from one to three months for the appearance of the spots.

II.—THE METAL

In order to determine whether the metal on which the sulphide finish is applied, affects the tendency for crystal spots to form, tests were made with sulphide finishes on sheet copper and brass, and on sheet steel plated with copper or brass. The results showed that there is no difference in the behavior of these metals. It is evident therefore that the crystal spots are connected with the copper sulphide itself, and not with the underlying metal.

III.—THE COLORING

1. Composition of Films: Experiments were made with black films produced on copper or brass by (1) the action of potassium or sodium polysulphide, (2) black nickel plating from sulphocyanate solutions, (3) black nickel plating from nickel chloride solutions containing no sulphur, and (4) copper carbonate black. The results showed that spots appeared only upon (1) and (2), i.e., those in which sulphur was present in the films.

2. Preparation of Films: In order to determine whether any of the materials other than the sulphide used in the preparation of the sulphide films were responsible for the spots, films were produced by exposing to hydrogen sulphide, copper that had not been subjected to any acids or alkalies. The black film so produced resembled that made with sodium or potassium polysulphide, and showed the same tendency for crystal spots. As in this reaction nothing but copper sulphide can be formed, it is evident that neither acids or alkalies are necessary for the formation of these spots.

IV.—THE COATING

1. Relation of Lacquer to Spots: Experiments with lacquered and unlacquered specimens showed that although certain conditions such as exposure to sulphur would cause discoloration of the unlacquered specimens, no crystal spots appeared except on the lacquered specimens. Evidently the presence of a film of lacquer or similar material is necessary for the formation of such crystals.

2. Thickness of the Lacquer: Experiments with thick lacquer films, produced by applying three coats of lacquer, showed that while the formation of crystal spots was somewhat retarded, the improvement was not sufficient to warrant the extra trouble and expense.

3. Composition of the Lacquer: As the crystals apparently grow between the surface of the sulphide film and the lacquer film, it appeared possible that by increasing the adherence of the lacquer the formation of the spots might be retarded or prevented. Over twenty experimental nitro-cellulose lacquers were prepared and tried out for this purpose. These contained variable proportions of linseed oil, varnish, castor oil, fish oil, and other additions. Although none of these lacquers entirely prevented spotting out, those containing linseed oil showed a marked improvement in this respect. Unfortunately, however, lacquers containing linseed oil show a tendency to discolor the finish, both on the dark and the relieved portions, and hence their use is impracticable.

4. Acidity of the Lacquer: As it was suggested that free acid in the lacquer might cause or accelerate the spotting, experiments were made with carefully neutralized lacquers, and with lacquers containing appreciable free acid. The spotting occurred equally with all these lacquers. The lacquers with free acid tarnish the surface, but do not affect the crystal spotting.

5. *Sulphide Particles in the Lacquer:* It was also suggested that the presence of suspended particles of copper sulphide in the lacquer, such as might be scraped or washed off of the "oxodized" surfaces during the lacquering might accelerate the spotting. Some of the sulphide was therefore scraped off and mixed with lacquer which was then applied. No evidence was found that the presence of such particles affected the formation of crystals.

6. Substitutes for Lacquer: In order to determine whether transparent coatings other than nitro-cellulose lacquers might be beneficial, experiments were made under accelerated conditions with shellac, varnish, and bakelite. With shellac and bakelite coatings, crystal spots were produced as readily as with lacquer. With spar varnish there was little or no formation of crystal spots, but the varnish reacted with the copper sulphide to form a green color, and was therefore unsatisfactory.

V.—THE SURROUNDINGS

1. Sulphur: Contact with sulphur is the most rapid means of accelerating the formation of crystal spots. If the surfaces are

sprinkled with powdered sulphur, spotting usually occurs in a few days. Even in this case, however, it is probably the sulphur vapor, produced by the very slow evaporation of the sulphur, that causes the spots. Experiments with lump sulphur, contained in the same vessel with the specimens, but not in contact with them showed that it also accelerates spotting, but not so rapidly as does the powdered sulphur.

2. Rubber: Rubber usually contains free sulphur, and in these tests it was found to produce the spots as readily as does powdered sulphur. That the effect of ordinary rubber is due principally to the presence of free sulphur on the surface, and its evaporation, is evident from some experiments with a special "non-blooming" rubber that contains little or no free sulphur. It was found that with the non-blooming rubber only about one-third as much spotting is produced as with ordinary rubber.

3. Sulphur Compounds: Experiments with air containing from 0.1 to 1.0 per cent by volume of hydrogen sulphide showed that with even the lowest concentration, crystal spots occur, but not so rapidly as with free sulphur. The hydrogen sulphide also causes tarnish. Air containing 1 per cent of sulphur dioxide causes rapid tarnish of the specimens, but no formation of spots.

4. Paper: Extensive experiments have shown that the spotting is accelerated by contact with certain papers, especially kraft paper such as is often used for wrapping. Actual contact with the paper appears necessary to produce the spotting. Thus when two or more specimens were so wrapped that the paper came in contact with only one side of each plate, crystal spots appeared only on that side. It is difficult, however, to show a direct relation between the sulphur content of the paper and the effect on spotting. Filter paper with only 0.0007 per cent sulphur caused about as much spotting as kraft paper with 0.002 to 0.003 per cent of sulphur, or cellophane with 0.005 per cent of sulphur. It is equally difficult to attribute the spotting to any constituents of the paper other than the sulphur.

5. Determination of Sulphur in Paper: The various methods that have been used or suggested for detecting or determining sulphur in paper all relate to the sulphur which is present as sulphide or in some form that may evolve hydrogen sulphide under certain conditions. Inert substances such as calcium sulphate that may be used as fillers, are not included in the determination of sul-

phur as conducted for this purpose. Among the methods suggested are (a) wrapping polished silver in the moistened paper and determining the extent of the tarnish; (b) heating the paper with zinc and hydrochloric acid, bringing the evolved hydrogen sulphide in contact with moist lead acetate paper and noting the color produced; and (c) treating the paper with zinc and hydrochloric acid, passing the gases into an alkaline cadmium solution, and titrating the hydrogen sulphide by the method used in determining evolution sulphur in steel. Of these (b) was found most promising, as (a) is not suited for quantitative work (except perhaps to detect some minimum content of sulphur). (c) is difficult to apply with small samples of the paper and with larger samples it is difficult to expel all the sulphur.

A large amount of work was required to so define the conditions in method (b) as to yield concordant and reliable results. It was found that the paper must be finely macerated, and that at least two grams of zinc, and 20 cc. of concentrated hydrochloric acid (diluted to about 100 cc.) must be used for each gram of paper; and the heating, with occasional boiling, should be continued for at least one hour to expel all the hydrogen sulphide. Color standards are prepared by introducing in blank experiments known small amounts of sodium thiosulphate. The standard lead sulphide papers thus produced vary in color with the amount of sulphur present, and can be kept in a closed dry vessel for long periods without changing color. It was found that with the conditions selected, reliable results can be obtained not only for ordinary wrapping paper and cardboard, but also for wax paper or oiled paper; which give misleading results under other conditions.

6. Effect of Humidity: As it is commonly believed that high humidity is partly responsible for the formation of these crystal spots, an extended study of this subject was made. The specimens were kept in desiccators with a definite moisture content, controlled by the concentration of the sulphuric acid in the desiccator.

Experiments in which the samples were kept in 90 per cent humidity without any rubber, sulphur, paper or other accelerating agent present, showed at the end of eight months very few spots. It is evident therefore that moisture alone does not cause or accelerate this type of spotting.

When the specimens together with rubber or sulphur were kept

in vessels with respectively zero, 20 per cent, 55 per cent, and 90 per cent humidity, the spotting occurred to an equal extent. It is evident therefore that the accelerating action of sulphur is not appreciably influenced by the humidity.

Specimens wrapped in various kinds of paper were subjected to similar variations in humidity. No differences in the spotting were observed except with "cellophane" paper, which contains more sulphur (0.005 per cent) than any of the other papers used. With this paper a high humidity appeared to increase the tendency toward spotting and also caused tarnishing.

7. Effect of Oxygen: As spots formed occasionally, though slowly, when no sulphur, rubber or paper was present, it was thought that the oxygen of the air might contribute to their formation. The fact that when specimens in contact with sulphur were kept in a vacuum for 75 days, no spots appeared although tarnishing occurred, seemed to confirm the view that oxygen is necessary. When, however, other specimens and sulphur were kept in pure oxygen and pure nitrogen respectively, spotting occurred to an equal extent in each. This shows that oxygen is not necessary; and leaves unexplained the results obtained in a vacuum.

VI.—THE COMPOSITION OF THE CRYSTALS

The fact that these crystals form only when copper and sulphur are present, at least indicates that they consist of copper sulphide. Two forms of copper sulphide occur naturally, cupric sulphide CuS, as the mineral covellite, and cuprous sulphide, Cu_2S, as the mineral chalcocite. The crystals present in the spots are exceedingly thin and so light that it was impracticable to collect enough for a chemical analysis. Mineralogic and petrographic examination also failed to determine the identity of the crystals.

It was therefore decided to make an X-ray examination. A small amount (about 1 mg.) of the crystals was obtained by removing the lacquer with butyl acetate, after which the crystals could be brushed or floated off without disturbing the under layer of black copper sulphide. Some of the latter was also scraped off for purposes of comparison. X-ray patterns were then made of (a) the crystal spots, (b) the black coating, (c) covellite and (d) chalcocite. The pictures showed very conclusively that both the crystals and the black coating have a pattern identical with chalcocite, and different from covellite. They are therefore both cuprous sulphide, Cu_2S.

The crystals of cuprous sulphide may conceivably be formed in either of two ways, (a) by a recrystallization of the much finer (but also crystalline) coating produced by the action of the sodium polysulphide on the copper, or (b) by the formation of new cuprous sulphide by the slow action of sulphur upon minute areas of copper that may be exposed through the original sulphide film. The latter view is rendered more plausible by the fact that (1) the crystal formation is accelerated by the presence of sulphur vapor, and (2) the crystals are most likely to form where there is a slight scratch, which may penetrate not only the lacquer but also the sulphide film. At best it is still difficult to fully explain the formation of these crystals. It is possible that the presence of the small amounts of sulphur simply "catalyzes" the formation of the crystals by a process of recrystallization.

VII.—POSSIBLE REMEDIES

The only promising methods of preventing the crystal spots would be (1) to employ finishes containing no sulphur, or (2) to prevent sulphur or sulphur compounds from coming in contact with the finishes. As (1) would involve a complete change in the methods of manufacture it could be considered only if conditions were far more serious than at present. The second remedy can be accomplished by (a) keeping the articles away from sulphur, rubber, or paper with a high sulphur content; or (b) applying some lacquer or similar coating which is practically impervious to sulphur. (a) is largely a matter of conditions in the manufacture, storage, transportation and display, which can be controlled at least enough to avoid flagrant access of sulphur. In addition it is possible to exclude sulphur and prevent the spotting (unless large amounts of sulphur are present), by the use of impervious wrappings such as tin foil and wax paper. The former is quite expensive, but the latter might be warranted if extreme conditions of spotting are encountered. Tests were also made with "anti-tarnish" paper, which consists of paper impregnated with lead acetate or zinc acetate. These tests indicated that when such papers are dry (i.e. at ordinary humidity) they show very little tendency to absorb sulphur or hydrogen sulphide. It is doubtful therefore whether they would effectively exclude sulphur except possibly in a very high humidity.

Under (b) it is still possible that some lacquer or other coating may be discovered or developed that will be superior to the ordi-

nary nitro-cellulose lacquers. We are now investigating several such coatings.

The only film that has thus far been found to prevent crystal spotting under most conditions is a grease film, such as may be applied to the lacquered surface by dipping the articles in a dilute solution (4 per cent or less) of petrolatum in carbon tetra-chloride. When the solvent evaporates, the remaining film may be wiped to remove most of the grease. This method is relatively inexpensive, but produces a finish that is somewhat objectionable. Here again such a remedy is only warranted if for any reason the spotting is so serious that extreme measures must be used, at least temporarily. Even this method however will not prevent some spotting if large amounts of sulphur are present in the surroundings.

VIII.—PLANT TESTS

In order to determine whether the laboratory experiments with grease films and wax paper are confirmed in practice, a large number of samples have been so treated in several plants. These, together with control samples, will be subjected to marine and railway transportation and to storage under different conditions. Several months will be required before definite conclusions can be drawn from these plan tests.

In the meantime the study of stain spots will be undertaken. Considerable information and numerous samples have been obtained and exploratory tests are now under way to determine the principal factors involved.

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